Enabling Materials for Aerospace Applications

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TeXpo
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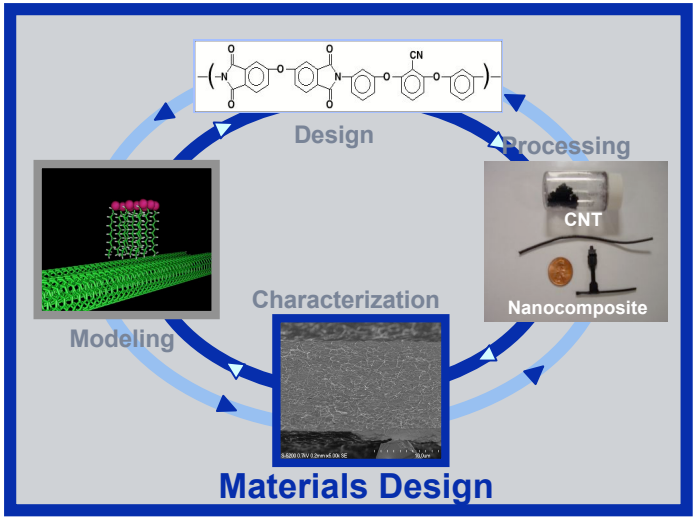
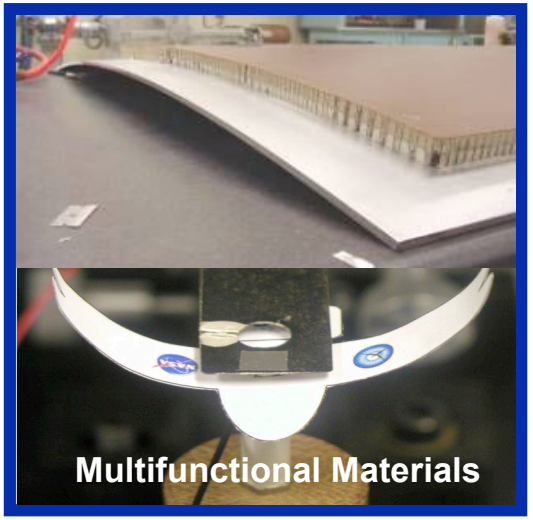
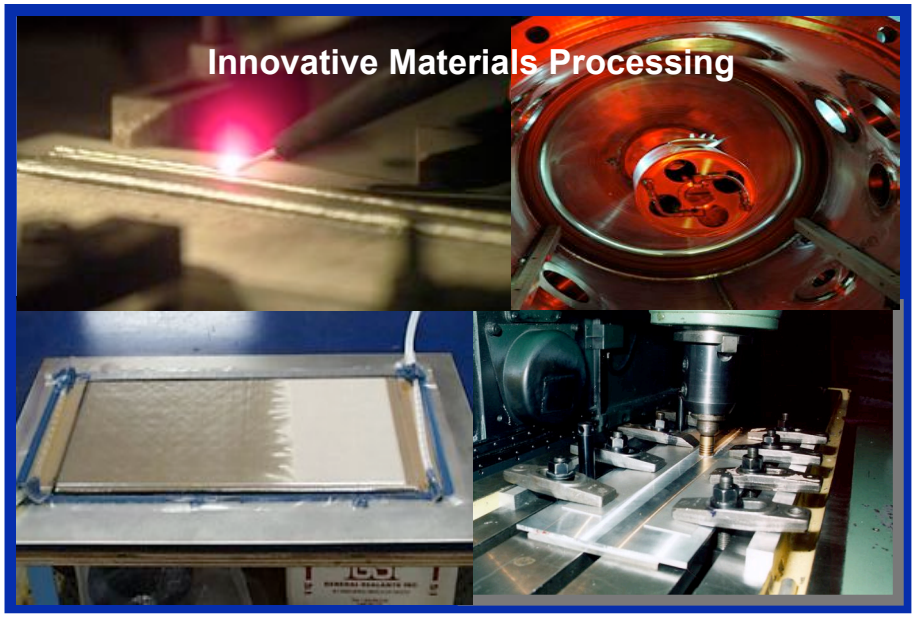
Advanced Materials and Processing
Research Thrusts







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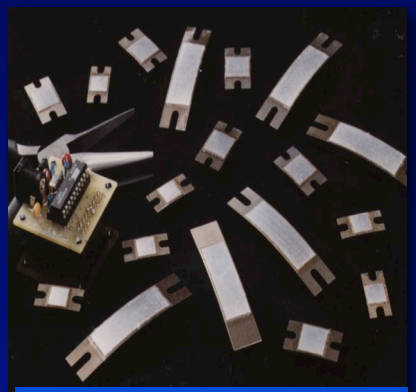
Track Record of Innovation

Licensed to diverse industries:

- **Aerospace**
- **Medical**
- **Electronics**
- **Cosmetics**
- **Utilities**
- **Sports/Recreation**

R&D 100 Winners Since 1996



1996/THUNDER Actuators

1997/PETI-5 High Temperature Polymer

1999/Colorless Films

2000/Macro Fiber Composite Actuators

2000/Al/Lithium Alloys

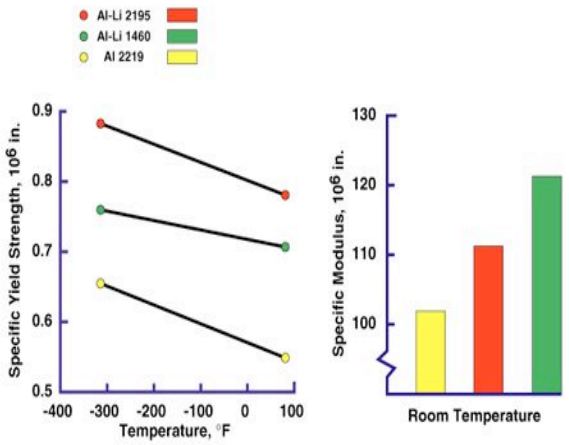
2000/Atomic Oxygen Resistant Polymers

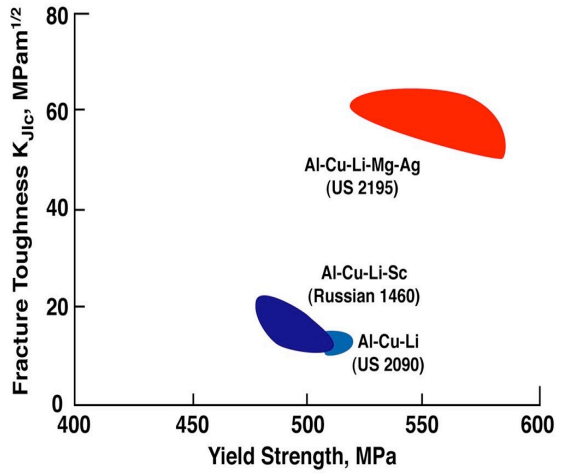
2001/Polyimide Foam

2005/PETI-330 High Temperature Transfer Molding Resin

Advanced Aluminum Alloys & Fabrication
Near Net Shape Fabrication Processes

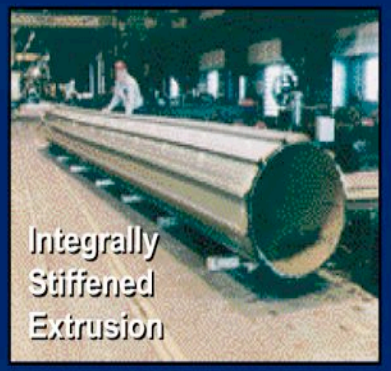
Alloys • 2219 • 2014 • 2195 • 2090 • 1460





Processes

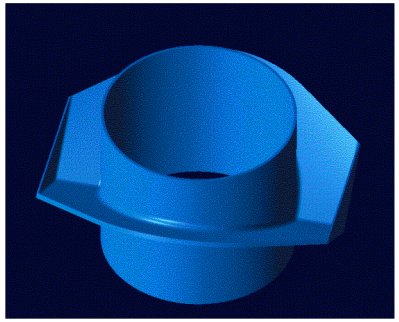
- Near-Net-Extrusion
- Roll Forging
- Shear Forming
- Spin Forming
- Friction Stir Welding



Applications

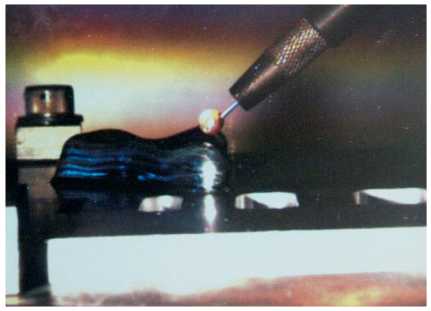
- Cryotank Barrel Sections
- Adapter Rings
- Cryotank Domes
- Intertank & Other Dry Bay Structures

Electron Beam Freeform Fabrication (EBF^3) at NASA LaRC



Ground-Based System for Aircraft Structural Components

- Layer-additive process for structural metal parts
- ~100% dense, direct from CAD file without molds, tooling, or machining offers cost & lead-time reduction
- Material properties similar to those of annealed wrought products



Portable System for Space Applications

- First successful microgravity demos February 2006
- Microgravity tests support fabrication, assembly & repair of space structures
- Portable system also suitable for self-supportability needs, such as on-demand fabrication of tools and replacement parts

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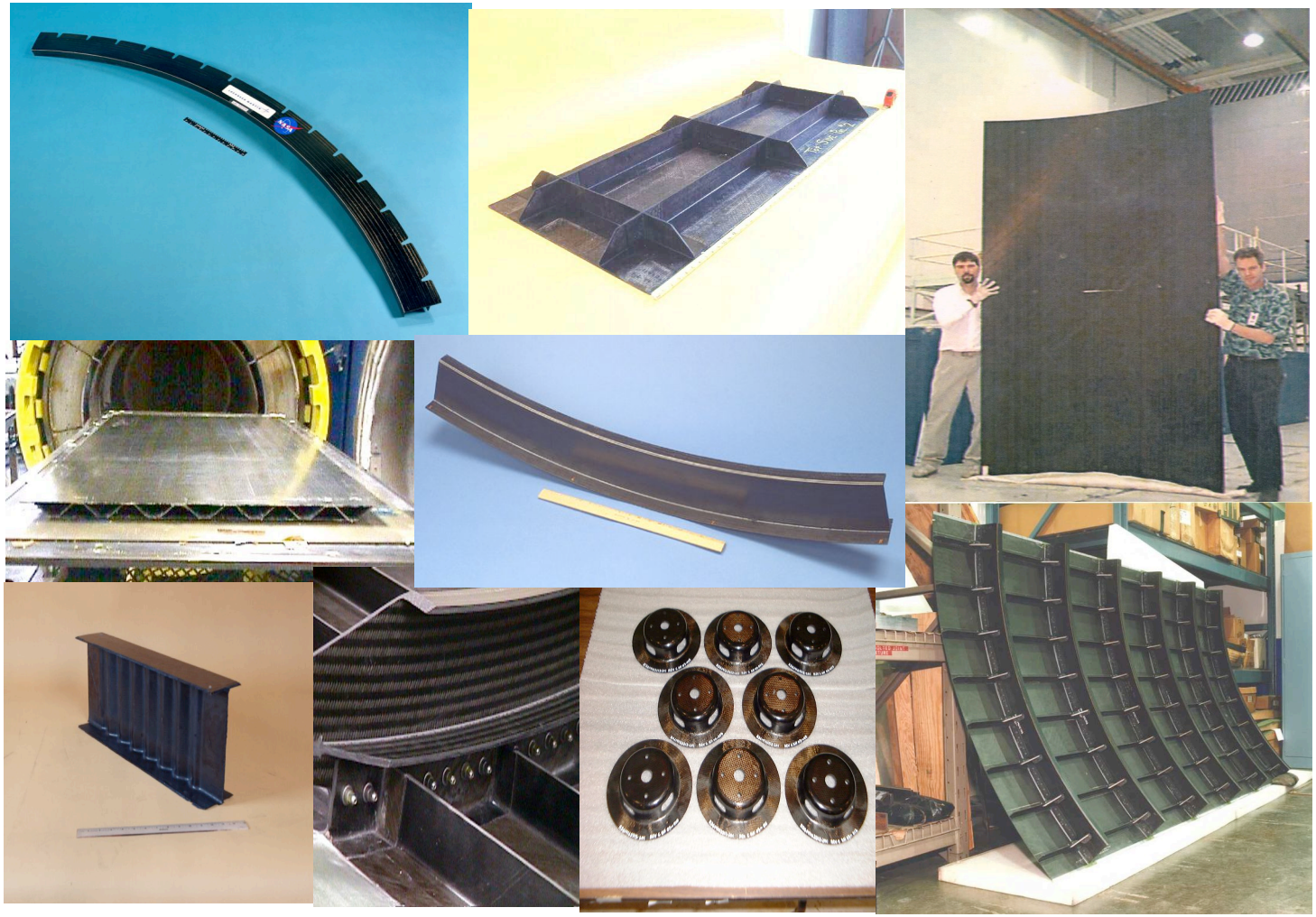
High Temperature Polymers and Adhesives



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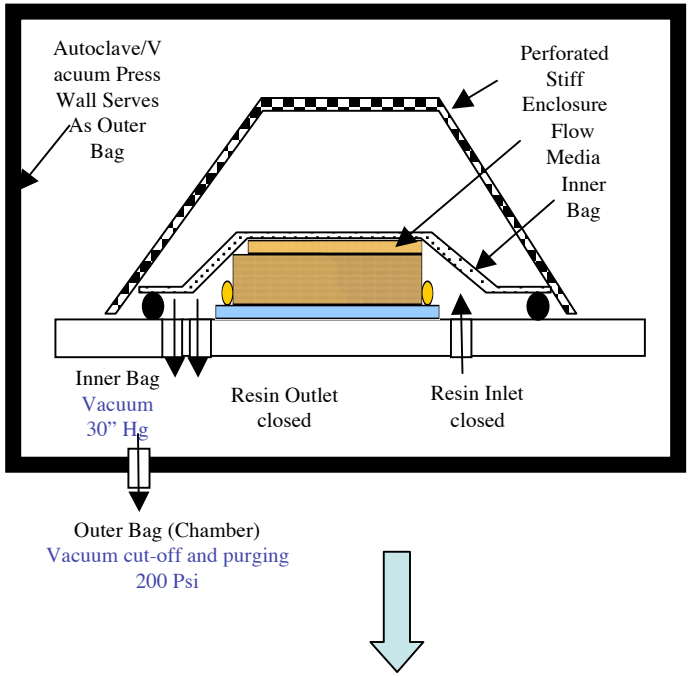
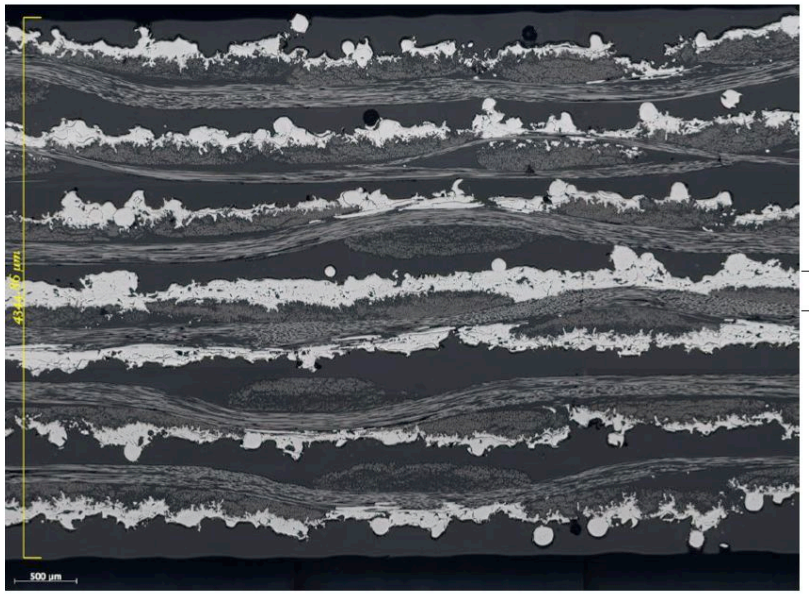
Advanced Composites Processing





Hybrid Laminates

Double Vacuum Bag VARTM

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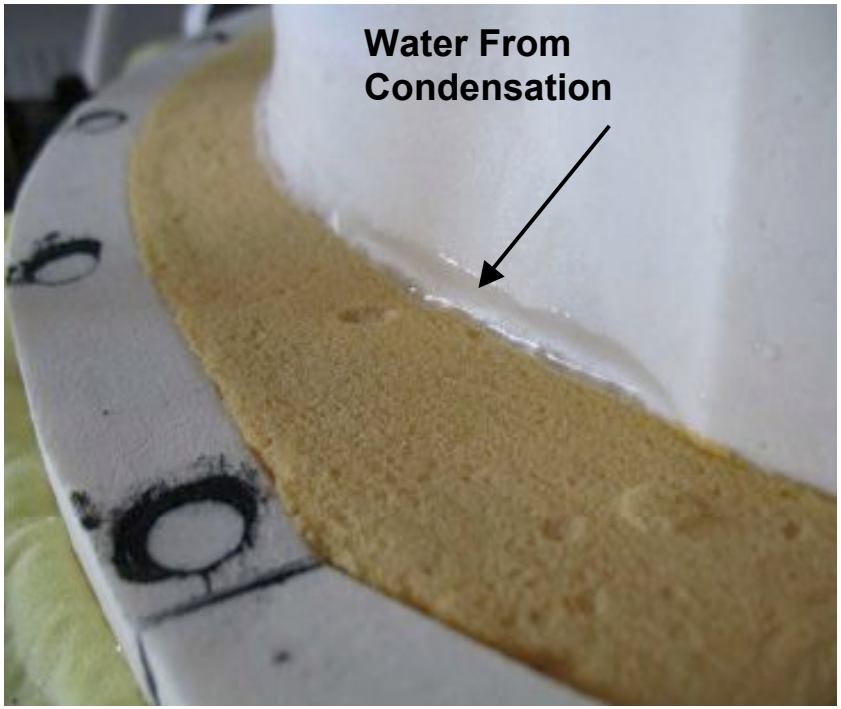
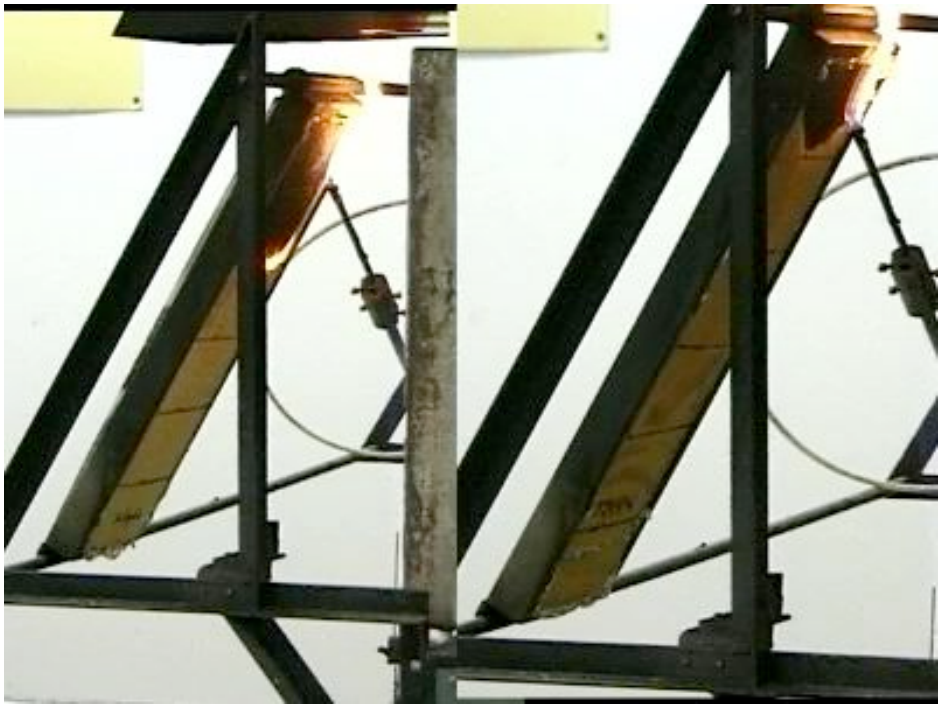
Foams for Extreme Conditions





- Minimizes ice formation
- Flexible at cryogenic temps
- Minimal weight (0.04 lb)

- Flame retardant foam compositions

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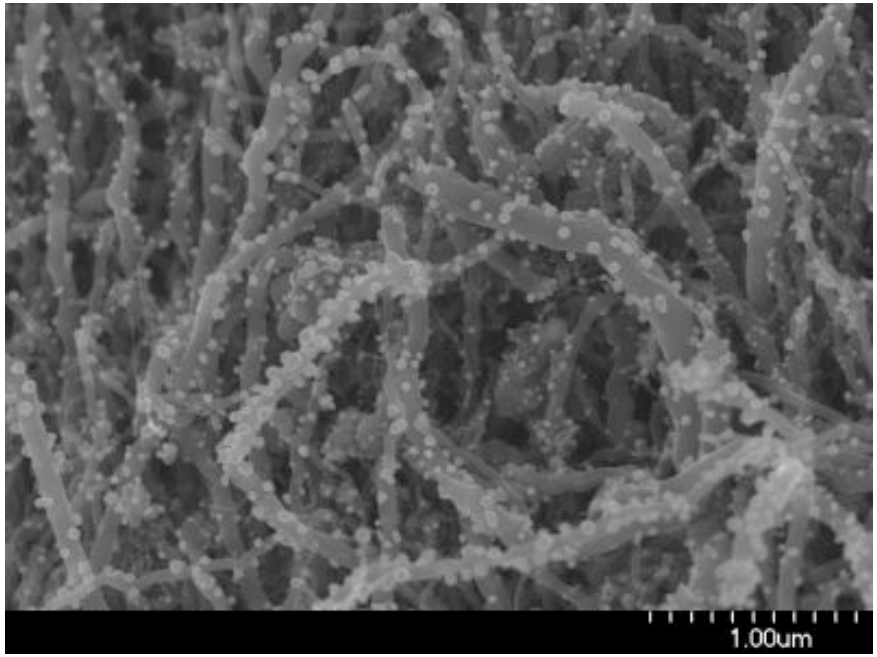
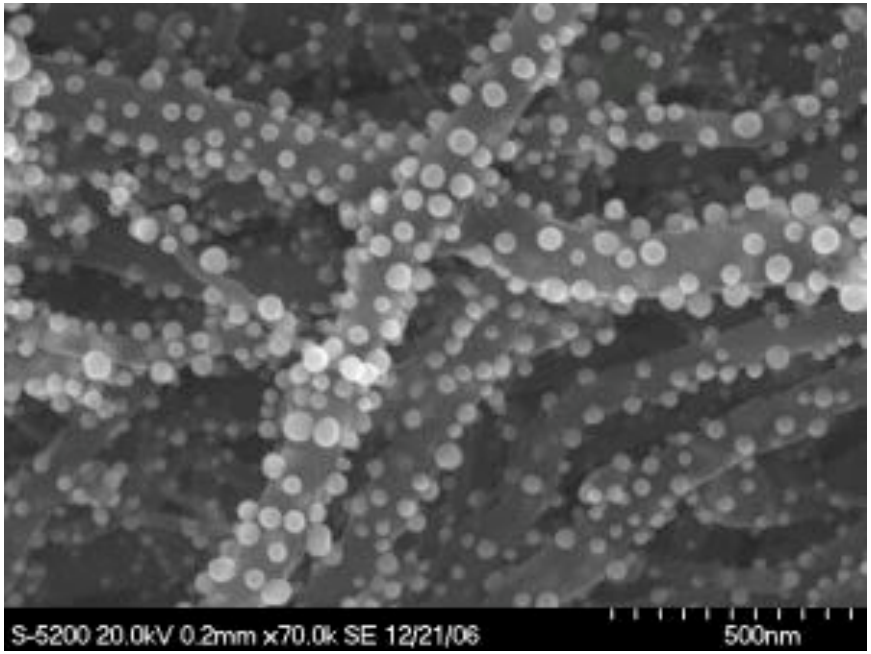
Metal Decorated Nanotubes





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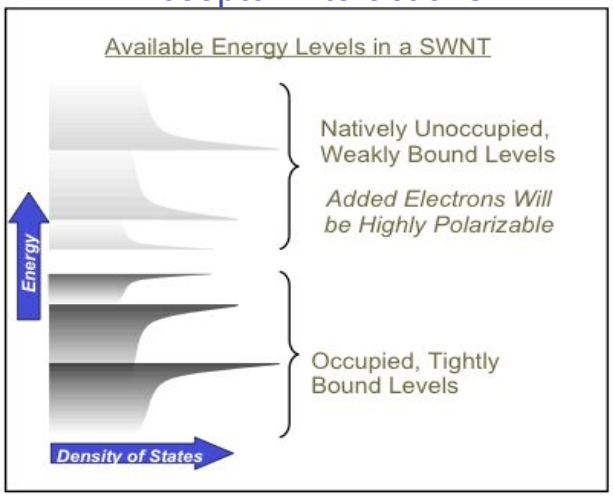
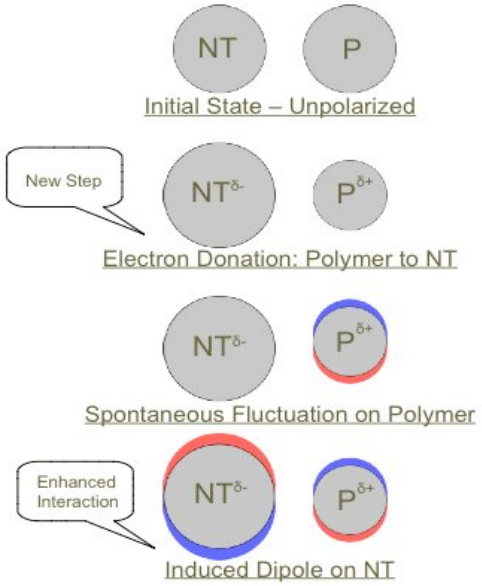
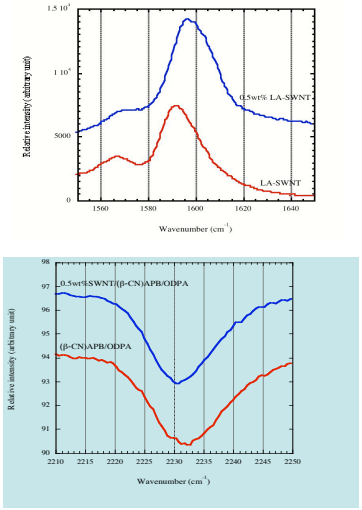
Coupling Modeling with Experiments to Aid Nanocomposite Design

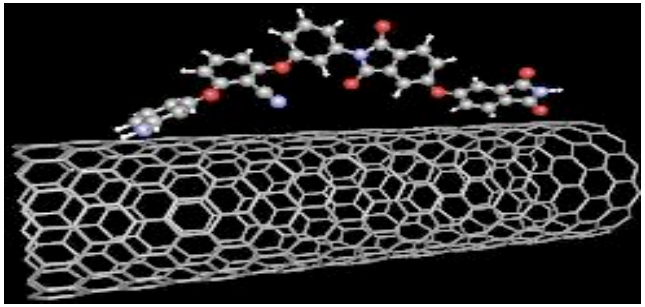
Schematic of Proposed Donor-Acceptor Interactions



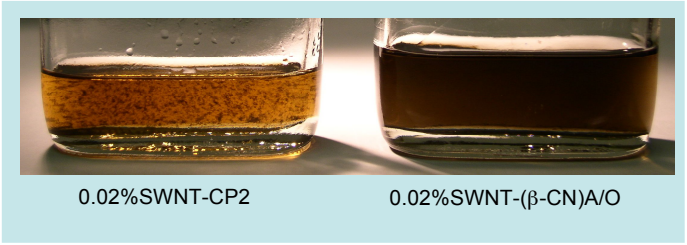




Experimental Evidence of Donor-Acceptor Interactions



Quantum Chemical Modeling



Observed Differences in Nanocomposite Solution Stability

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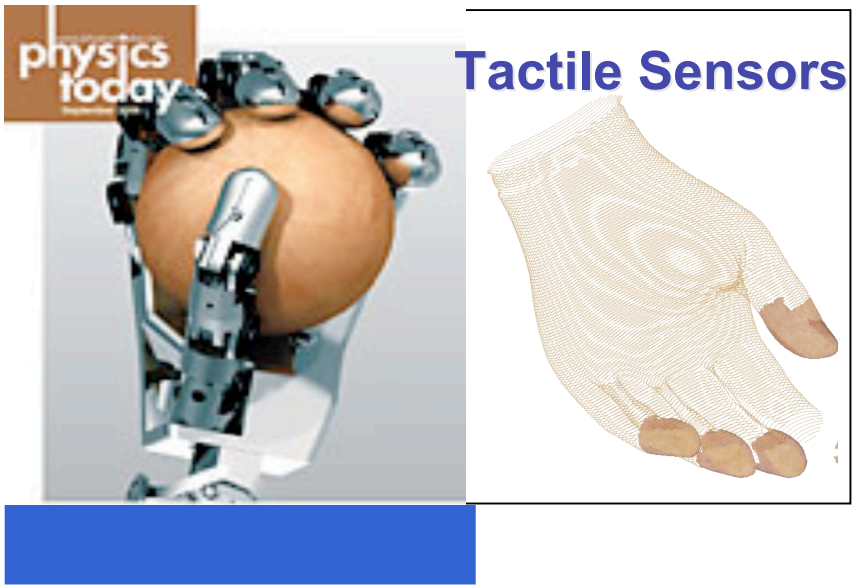
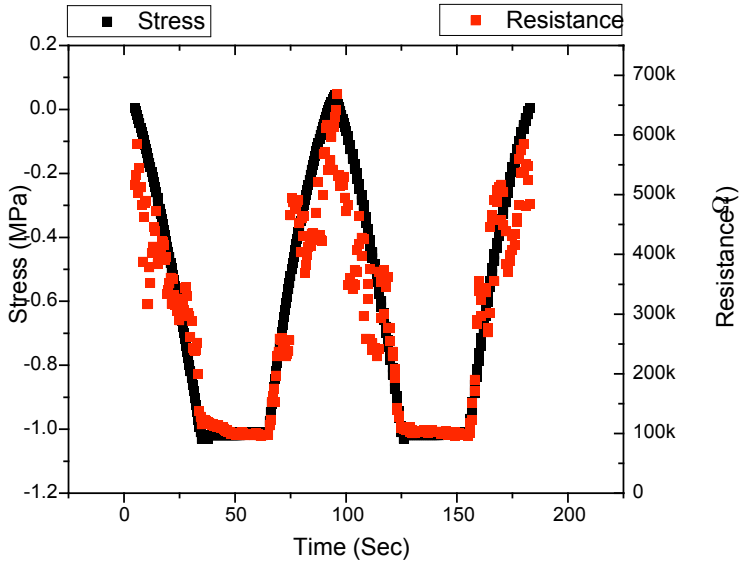
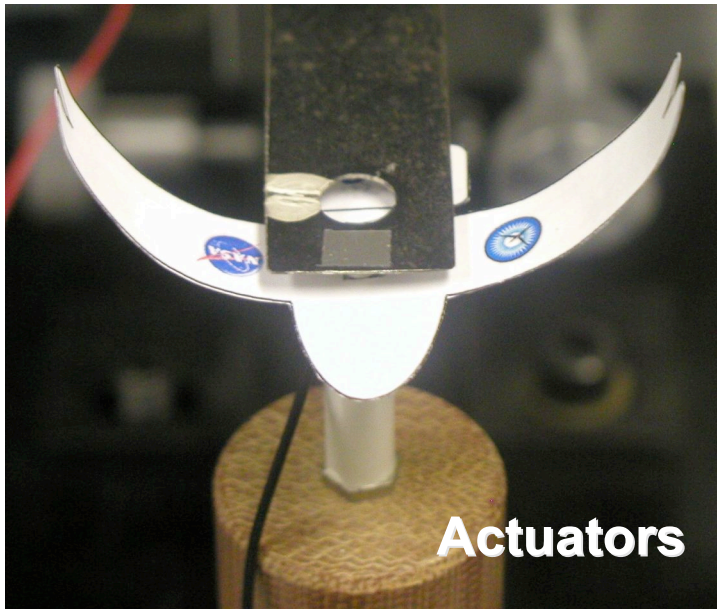
LaRC Electroactive Materials





Material	Out-of-plane Strain	Electric field	Young's Modulus
PVDF	0.1%	50 MV/m	1600 MPa
SWNT/Polyimide	**2.6%**	**0.8 MV/m**	**3500 MPa**
Polyurethane	11%	100 MV/m	17 MPa
PZT	0.1%	1 MV/m	62 GPa



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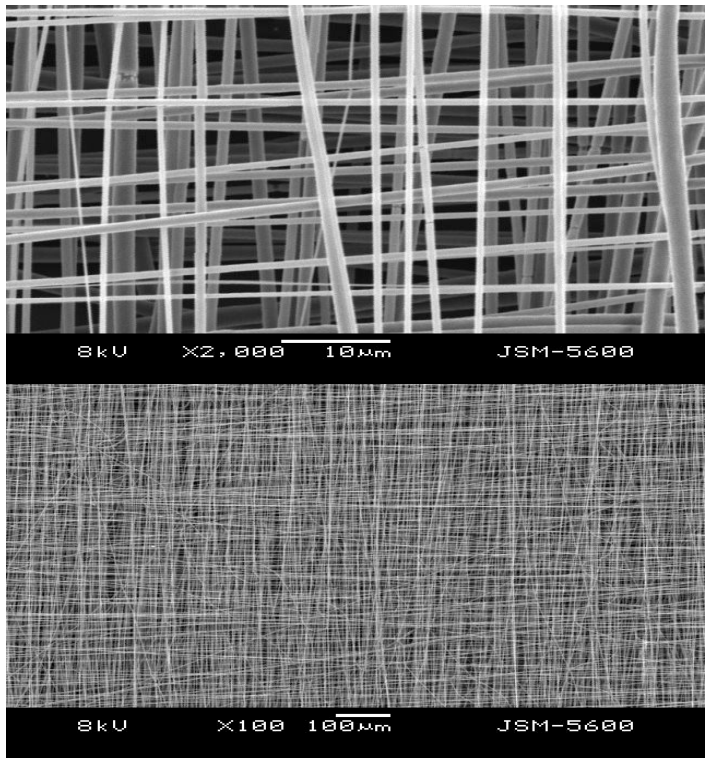
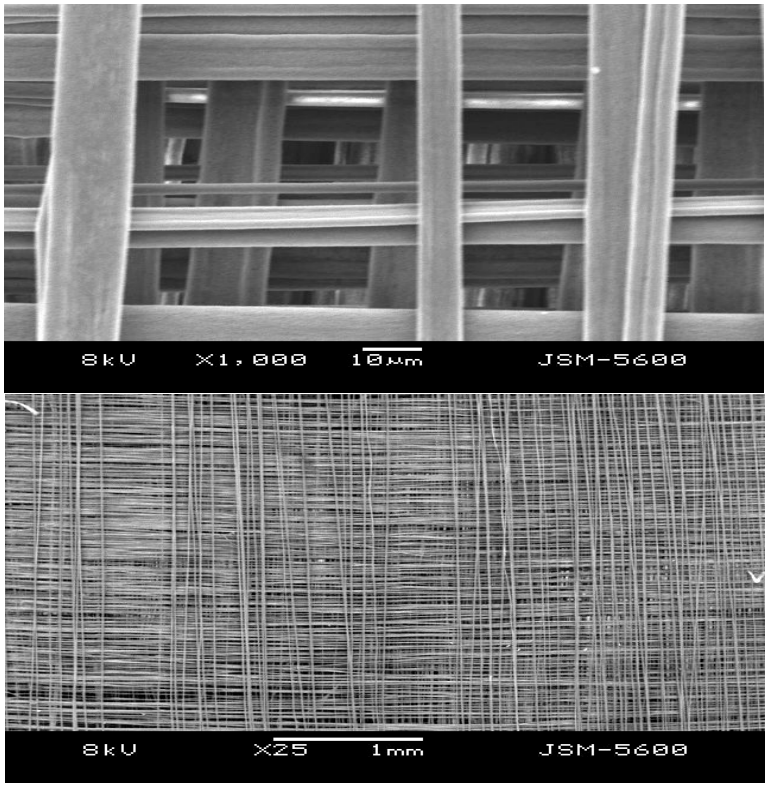
Micro and Nano Fibrous Mats

30 Layer Aligned Mats



PGA 30 Layer mat: top image at 2000x; bottom image at 25x



CP2 30 Layer mat: top image at 1000x; bottom image at 100x

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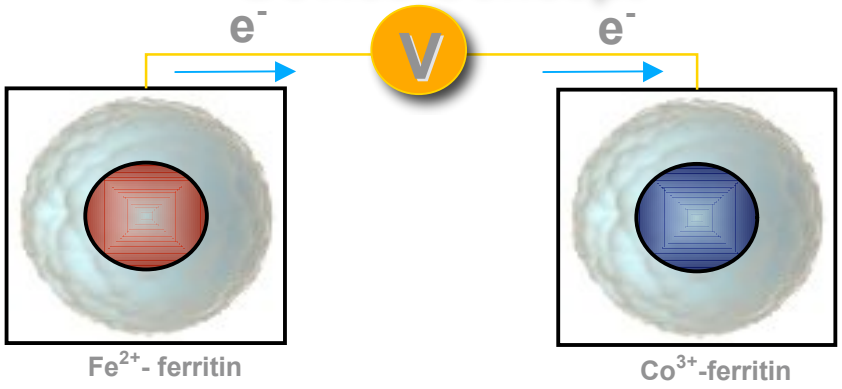
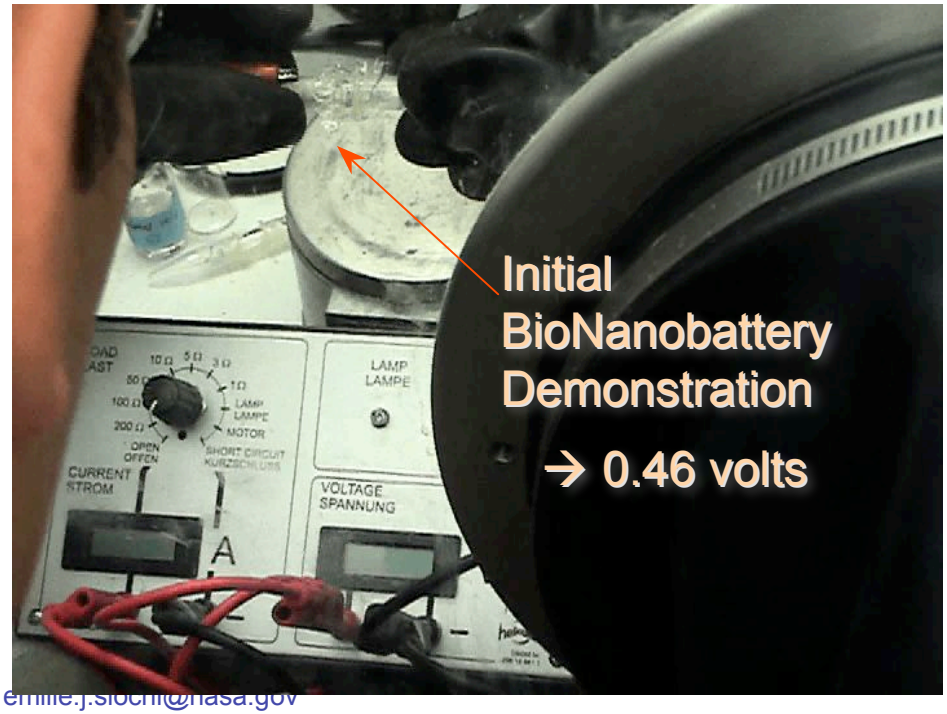
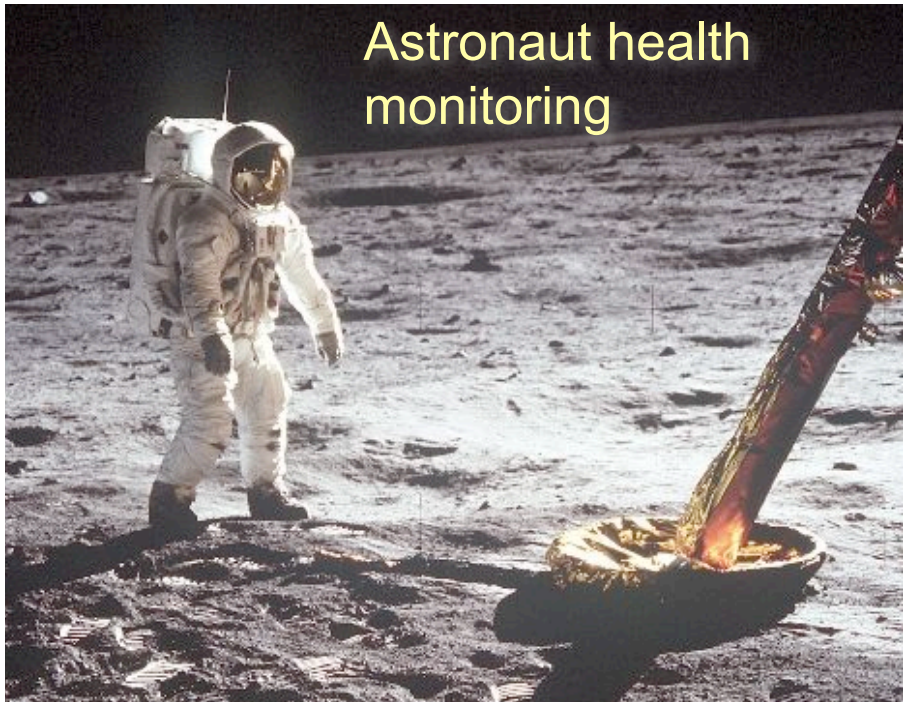
Biocompatible Power Generation and Energy Storage

Device Concept



Fully biocompatible, using proteins naturally found in the body
Tailorable, by choice of redox couple
Controllable architectures





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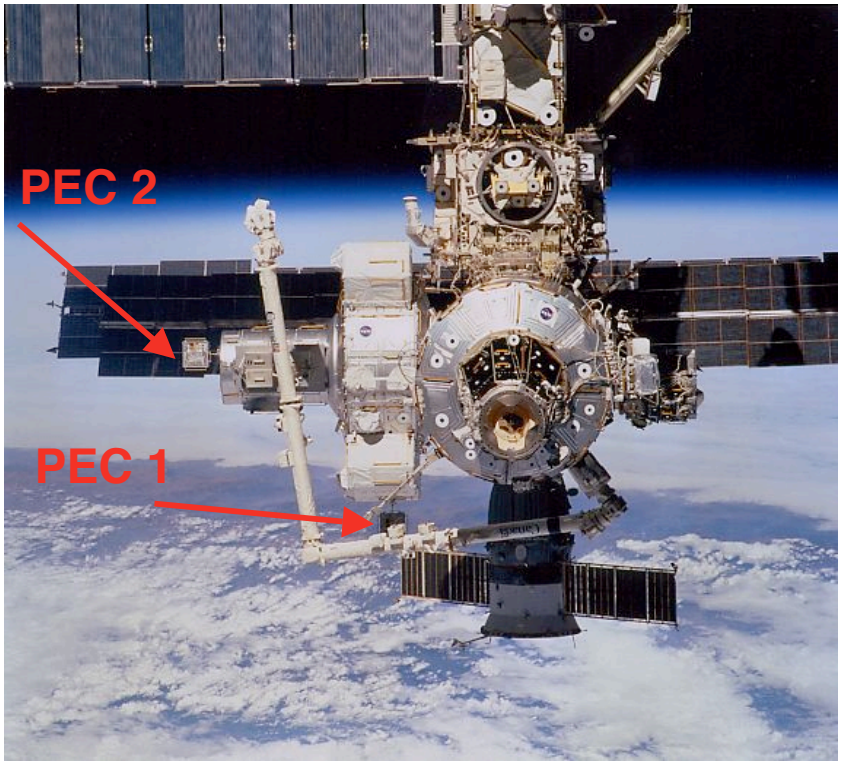
MISSE Materials International Space Station Experiment



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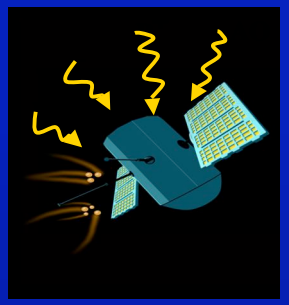
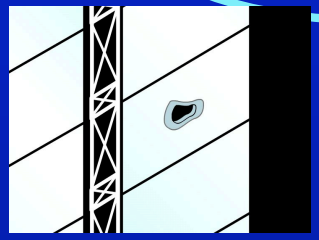
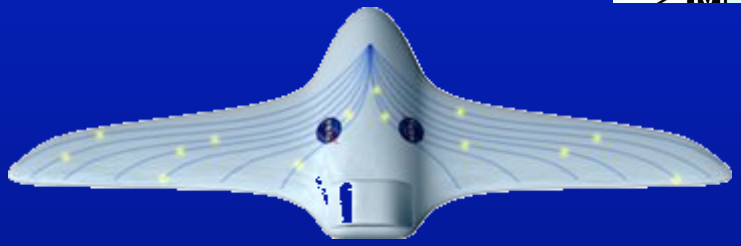
Accelerating Pace of EmergingTechnology Insertion

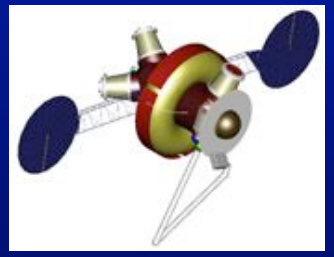
University

Industry









Government

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